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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|---------------------|------------------|
| 09/313,764 | 05/18/1999 | AKITO KURAMATA | 990527 | 4289 |
| 38834 | 7590 | 02/14/2005 | EXAMINER | |
| WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP 1250 CONNECTICUT AVENUE, NW SUITE 700 WASHINGTON, DC 20036 | | | COLEMAN, WILLIAM D | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2823 | |

DATE MAILED: 02/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | |
|------------------------------|------------------------------|------------------|
| Office Action Summary | Application No. | Applicant(s) |
| | 09/313,764 | KURAMATA ET AL. |
| | Examiner W. David Coleman | Art Unit 2823 |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 03 February 2005.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-24 is/are pending in the application.
 - 4a) Of the above claim(s) 5 and 14-17 is/are withdrawn from consideration.
- 5) Claim(s) 6-13 and 18-20 is/are allowed.
- 6) Claim(s) 1-4 and 21-24 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 - Certified copies of the priority documents have been received in Application No. _____.
 - Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.

- 4) Interview Summary (PTO-413)
Paper No(s)/Mail Date: _____.
- 5) Notice of Informal Patent Application (PTO-152)
- 6) Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on April 30, 2002 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 2, 3, and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Edmond et al., U.S. Patent 6,120,600 in view of Nakamura et al., U.S. Patent 5,747,832.

4. Pertaining to claims 1, 2, 21, 22 and 23, Edmond (600) discloses a semiconductor device substantially as claimed. See FIGS. 1, where a silicon carbide (SiC) substrate **21** has a first conductivity (n-type) and a buffer layer formed on the substrate **21** with a composition represented by the compositional parameter x as $\text{Al}_x\text{Ga}_{1-x}\text{N}$. Also Edmond teaches an embodiment wherein the buffer layer comprises a graded composition of silicon carbide aluminum gallium nitride (column 5, lines 63-67 and column 6 lines 1-6). A first cladding layer **23** comprises a first conductivity type (n-type) formed epitaxially, an active layer **25** formed

epitaxially formed on the first cladding layer. A second cladding layer **30** having a second opposite conductivity type (p-type). The second cladding layer is of an epitaxial nature (see columns 7-8, where Edmond discloses epitaxial growth temperatures and process). A first electrode **31** is provided to inject first-type carriers having a first polarity into the second cladding layer **30** and a second electrode **32** provided on the substrate so as to inject second type (p-type) carriers having a second polarity. The buffer layer having a compositional parameter x larger than 0 but smaller than 0.4 ($0 < x < 0.4$) as seen in **FIG. 6**. Please note that FIG. 1 does not include an insulating layer. However, Edmond fails to disclose the carrier concentration in the range as claimed. Nakamura discloses an $\text{Al}_x\text{Ga}_{1-x}\text{N}$ layer comprising a carrier concentration of $1 \times 10^{20}/\text{cm}^3$ (column 14, line 3) also pertaining to claim 21, the p-type layer is doped with Mg (column 6, line 63). In view of Nakamura, it would have been obvious to one of ordinary skill in the art to teach the claimed carrier concentration because the claimed ranged provides a low-resistivity layer (column 13, line 23).

5. Pertaining to claims 3 and 21, Edmond (600) discloses a semiconductor device having a compositional parameter x of a buffer of less than 0.09 (where $x < 0.09$). See **FIG. 6**, where the compositional parameters are shown.

6. Claims 4 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Edmond et al., U.S. Patent 6,120,600 in view of Nakamura et al., U.S. Patent 5,747,832 as applied to claims 1-3 above, and further in view of Powell et al., U.S. Patent 6,165,874.

7. Edmond (600) in view of Nakamura discloses a semiconductor device substantially as claimed as discussed above. However, the combined teachings fail to teach the crystal orientation of the silicon carbide substrate. Powell discloses a semiconductor device wherein the

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crystal orientation is taught as Applicant's claimed orientation. See column 7, lines 15-28, where silicon carbide polytypes are formed by the stacking of double layers of Si and C atoms. Each double layer maybe be situated in one of three positions, known as ABCACBABCACB... for 6H. The stacking direction is designated as the crystal c-axis and is in the crystal [0001] direction; it is perpendicular to the basal plane which is the crystal (0001) plane. In view of Powell, it would have been obvious to one of ordinary skill in the art to claim a silicon carbide substrate having a crystal orientation of (0001) in the combined teachings of Edmond (600) and Nakamura because the GaN based Group III and Group V nitrides semiconductors have bonded polytypes similar to those of SiC (column 7, lines 46-50).

Allowable Subject Matter

8. Claims 6-13 and 18-20 allowed.
9. The following is an examiner's statement of reasons for allowance: prior art does not teach a semiconductor device wherein a substrate of SiC having a first conductivity type; the third cladding layer forming a ridge structure having a T-shaped cross-section, the third cladding layer including, at a bottom part thereof, a pair of cuts, such that the cuts penetrate from respective lateral sides of the ridge structure toward a center of the ridge structure.
10. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 571-272-1856.

The examiner can normally be reached on Monday-Friday 9:00 AM-5:30 PM.

11. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

12. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



W. David Coleman
Primary Examiner
Art Unit 2823

WDC